REMARKS

The Official Action dated October 15, 2004 has been received in its contents carefully noted. In view thereof, claim 5 has been amended and new claims 7-10 have been added in order to better define that which Applicants regard as the invention. Accordingly, claims 1-10 are presently pending in the instant application.

With reference now to Official Action, and particularly page 2 thereof, claims 5 and 6 have been rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which Applicant regards as the invention. Specifically, the Examiner notes in claim 5, line 7 "z.0" is vague and indefinite and should read the $z > 0$. As can be seen from the foregoing amendments, the Examiner is correct in his assumption and independent claim 5 has been amended in order to properly recite the equation set forth therein. Accordingly, it is respectfully submitted that Applicants' claimed invention has set forth in independent claim 5 as well as dependent claim 6 is now in proper formal condition for allowance.

With reference now to paragraph 2 of the Office Action, claims 1-6 have been rejected under the judicially created doctrine of obviousness-type double patenting as being unpatenetable over claims 1-6, 13 and 14 of U.S. Patent No. 6,632,746. The Examiner states that although the conflicting claims are not identical, they are not patentably distinct from each other because U.S. Patent No. 6,632,746 discloses an etching method for plasma etching an organic/inorganic hybrid film having low dielectric constant with same formula and using same etchants. It is respectfully requested that this rejection be held in abeyance until such time as pending claims 1-10 are indicated as being allowable of the remaining prior art of record, in that such claims may involve during the pending prosecution thereby overcoming the obvious-type double patenting rejection.

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With reference now to paragraph 4 of the Office Action, claims 1 and 3 have been rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,[illegible]24,154 issued to Miyasaka in view of Japanese Patent publication 407074245A or U.S. Patent No. 6,506,678 issued to Sukharev. These rejections are respectfully traversed in that the combinations proposed by the Examiner neither disclose nor suggest that which is presently set forth by Applicants' claimed invention.

As the Examiner can readily appreciate, independent claim 1 recites an etching method for plasma-etching an organic/inorganic hybrid film having low dielectric constant and represented by $SiC_xH_yO_z$ ($x>0$, $y\geq0$, $z>0$), comprising the step of plasma-etching the organic/inorganic hybrid film with an etching gas containing fluorine, carbon and nitrogen. That is, when a gas containing nitrogen comes in to contact with the surface of an organic/inorganic hybrid film represented by the above-noted formula, "CxHy" is chemically changed to highly volatile HCN or CN at the surface of the $SiC_xH_yO_z$ film and thus the proportion of the carbon component decreases in the surface portion of the organic/inorganic hybrid film. Therefore, the etching of the organic/inorganic hybrid film proceeds at roughly the same etching rate as that other silicon oxide film as noted on page 16, line 25 to page 17, line 10, of Applicants' specification.

With respect to the teachings of Miyasaka, it is noted from Figures 17 and 18, that a fabrication process for TFT is set forth with the process including sequentially performing the steps of forming an underlevel protection layer 11 and a semiconductor layer 12 composed of silicon on a glass substrate 10, depositing a gate insulator layer 13 consisting of a silicon oxide film on the semiconductor layer 12 using TEOS gas and O_2 gas, patterning the gate insulator layer 13 and the semiconductor layer 12 with a resist mask 22, and dry etching only the surface of the gate insulator layer 13 using etching gases such as CHF3, NF3 and SF6 to clean the surface of the gate insulator layer 13 as noted in column 24, line 66 to column 25, line 5 and column 32, lines 27-35.

With respect to the teachings of Japanese Patent publication No. 407074245A, this reference as shown in Figure 2, disclose a method for forming a multilayer wiring that includes the step of forming an interlayer insulating film 22, 24 which is made of a low dielectric constant SiO_2 film doped with F, on a silicon substrate 21 using TEOS gas, O_2 gas and NF_3 gas. Further, the patent to Sukharev teaches, a method of forming a wiring, with the method including sequentially performing the steps of forming a composite line 16 composed of Al/TiN/Ti on an underlying integrated circuit structure 2, forming a porous aluminum oxide layer 20 over the composite line 16, and forming a dielectric material, which is made of a low dielectric constant silicon oxide film doped with C, and utilizing the reaction of methyl silane and H_2O_2 such that gaps between the composite lines 16 are sealed as noted in column 7, lines 58-63, and column 2, lines 1-8 and further noted in Figures 1-4. Clearly, the teachings of the above noted references fail to disclose or suggest that is presently set forth by Applicants' claimed invention.

In rejecting Applicants' claimed invention, the Examiner notes that Miyasaka does not explicitly state that the oxide layer formed with an organic silane may be of low dielectric constant. Consequently, the Examiner relies on the teachings of the Japanese Patent publication or Sukharev, stating that it would have been obvious to one of ordinary skill in the art that the oxide formed with an organic silane may be of low dielectric constant. Further, in rejecting claim 3, the Examiner states that the secondary references teach that the organic/inorganic hybrid film is a low dielectric constant material, the carbon content of the film is simply a matter of choice of design depending on the product requirement and that it would have been obvious to one of ordinary skill in the art to change the compositions and concentration of the precursors to meet specific product requirement through routine experimentation. However, the reasons discussed hereinbelow, it is respectfully submitted that Applicants' claimed invention is neither disclose and nor render obvious by the opposed combination.

In rejecting Applicant's claimed invention, the Examiner asserts that the insulating film disclosed by Miyasaka deposited using TEOS gas is an organic/inorganic hybrid film composed of a silicon oxide film including organic components. This regard, attached hereto is a paper by S.Nguyen, et al., J. Electrochem. Soc., Vol. 137, No. 7 (1990) which according to this reference, an insulating film deposited by plasma CVD or thermal CVD of TEOS gas is a silicon dioxide film and the percentage of organic components included is extremely small. As particularly noted therein, Figures 3 and 4 (FTIR analysis of thermal CVD-TEOS film), illustrate that the silicon oxide film having SiO_2 as the main component includes a small amount of SiOH and H_20, however, no carbon component is detected. Furthermore, as set forth in Figure 7 (XPS analysis of thermal CVD-TEOS film), the film is substantially SiO_2 (the ratio of Si and O being 1:2) and a small amount of carbon component. As can be noted from Figures 11 and 12 (FTIR analysis of PCVD-TEOS film), the silicon oxide film having SiO_2 as the main component includes a small amount of SiOH, and an extremely small amount of carbon component is detected depending on the film forming condition while Figure 13 (XPS analysis of PCVD-TEOS film), similar to that of Figure 7 the film is substantially SiO_2 (the ratio of Si and O being 1:2) with a small amount of carbon component detected.

Consequently, it is respectfully submitted that the Examiner is incorrect in his assertion as to the teachings of Miyasaka in that Miyasaka fails to teach or suggest that which presently set forth by Applicants' claimed invention wherein performing plasma etching on the organic/inorganic hybrid film, which is represented by $SiC_xH_yO_z$ where $(x>0, y\geqq 0, z>0)$ using etching gas including fluorine, carbon and nitrogen. Additionally, the Japanese Patent publication and Sukharev merely disclose methods for depositing a low dielectric constant insulating film. Accordingly, for the reasons discussed herein above it is respectfully submitted that Applicants' claimed invention as set forth in each claims 1 and 3 clearly distinguishes over the combination proposed by the Examiner and is in proper condition for allowance.

Referring now to paragraph 5 of the Office Action, claims 1-6 have been rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 5,814,563 issued to Ding et al. in view of U.S. Patent No. 6,228,751 issued to Yamazaki et al. and Japanese Patent publication 407074245A or Sukharev. These rejections are respectfully traversed that the combinations proposed by the Examiner neither disclose nor remotely suggest that which is presently set forth by Applicants' claimed invention.

Initially, it is noted that similar to the Examiners assertion with respect to Miyasaka, the amount of carbon within the TEOS oxide film set forth by Yamazaki et al. is extremely small. Consequently, it is respectfully submitted that the Examiner incorrectly asserts that the TEOS deposited glass insulating film is an organic/inorganic hybrid film composed of silicon oxide film including organic components. Particularly, Yamazaki et al. teaches a method for manufacturing TFT shown in Figure 6, wherein Yamazaki et al. discloses that as an object of reducing carbon within the insulating film when the insulating film is being deposited using organic silane (for example TEOS gas), the silicon oxide film is formed by TEOS gas and O_2 gas. During the forming of the silicon oxide film, H_2 gas is added to the above gas mixture and active hydrogen having a carbon removing effect is being utilized, thereby forming the under film 302, the gate insulating film 305 and the interlayer insulating film 308 of which a quantity of carbon within the oxide film is being largely reduced. The Examiner's attention is directed to column 4, lines 20-24, column 6, line 65 to column 7, line 4, column 16, lines 29-35 and column 21, lines 50-53. Accordingly, the amount of carbon within the oxide film is being reduced from 1 x 10^{19} cm^{-3} to between 2 x 10^{1}[illegible] cm^{-3} and 7 x 10^{18} cm^{-3} as noted in column 20, lines 20-29.

With respect to the teachings of Ding et al., this reference teaches, as shown in Figure 1, a method for etching a dielectric layer with the method including sequentially performing the steps of forming an underlayer 26 composed of a doped polysilicon layer 28 and a diffusion layer 30 on a substrate 25, and forming a dielectric layer 20 composed of SiO_2, PSG or BPSG on the underlayer 26. Consequently, the substrate 25 is cooled under a low temperature so that a NH_3-generating gas is absorbed by the surface of the substrate 25, and a fluorohydrocarbon gas, for example a CHF_3 gas, is supplied to the surface of the substrate. Due to the reaction between the CHF_3 gas and the NH_3-generating gas, highly reactive NH_4F, HF, HF_2 and NH_4 species are generated, thus increasing the etching rate of the dielectric layer 20 and selectively achieving high etching as noted in column 3, lines 54-61, and column 6, lines 14-50. Ding et al. further discloses a TEOS deposited glass as an example of a dielectric layer in the background portion as noted column 4, lines 18-23. Consequently, it is respectfully submitted that the invention of Ding et al. is not limited to the etching of dielectric layers but can also be used to etch films which include non-oxide layer such as silicon, polysilicon, silicide, nitride, or boride layers, for example Ta_2O_5, Tio_2, TiN, WSi_x and $MoSi_x$. In other words, according to the disclosure Ding et al., the film to be etched is a film composed of an inorganic compound including no organic component.

Similarly, as is noted hereinabove, in the step of forming the silicon oxide film in Yamazaki et al., the insulating film of which the amount of carbon within the oxide film is greatly reduced is formed by adding H_2 gas to the TEOS gas and O_2 gas mixture. Hence, the insulating film of the Yamazaki et al. is a conventional silicon oxide film having a large dielectric constant.

On the other hand, the insulating film of the present invention is a low dielectric constant insulating film ($\varepsilon = 2\text{-}3$) composed of the organic/inorganic hybrid film represented by $SiC_xH_yO_z$ where ($x>0$, $y\geq0$, $z>0$). Hence, the structure of the insulating film in the present invention is clearly different from at set forth by Ding et al. when taken alone or in view of the teachings of Yamazaki et al. Further, with reference to Ding et al., as noted hereinabove due to the reaction between the CHF_3 gas and the NH_3-generating gas, highly reactive NH_4F, HF, HF_2 and NH_4 species are generated, and the etching rate of the dielectric layer is increased.

With respect to the Applicants' claimed invention, when a gas containing nitrogen comes into contact with the surface of the organic/inorganic hybrid film represented by $SiC_xH_yO_z$ where ($x>0$, $y\geq0$, $z>0$), "CxHy" is chemically changed to highly volatile HCN or CN at the surface of the $SiC_xH_yO_z$ film, and thus the proportion of the carbon component decreases in the surface portion of the organic/inorganic hybrid film. Therefore, the etching of the organic/inorganic hybrid film proceeds at roughly the same etching rate as that for the silicon oxide film. Hence, the reaction and mechanism of etching in the present invention is clearly different from that set forth by Ding et al. when taken alone or in view of the secondary references.

Furthermore, as noted hereinabove with respect to the teachings of Japanese Patent publication JP407074245A and Sukharev, each of these references merely disclose methods for depositing a low dielectric constant insulating film consequently do nothing to overcome the shortcomings associated with Ding et al. and Yamazaki et al. Accordingly, it is respectfully submitted that Applicants' claimed invention as set forth in claims 1-6 as well as new claims 7-10 clearly distinguishes over the combination proposed by the Examiner and is proper condition for allowance.

Therefore, in view of the foregoing, it is respectfully requested that the objections and rejections of record be reconsidered and withdrawn by the Examiner, that claims 1-10 allowed and that the application be passed to issue.

Should the Examiner believe a conference would be of benefit in expediting the prosecution of the instant application, he is hereby invited to telephone counsel to arrange such a conference.

Respectfully submitted,

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